iWire365
Connecting the World One Community at a Time
SMART Energy, Government
Public Safety, Telecommunications,
Business & Home

Wireless Communications Technical Brief

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Site Survey

Many organizations will perform only software modeling and make claims of a project's success, only to find that after a contractual agreement is made that the solution may not be fully achieved. This creates delays and change orders in a project or can result in the total failure of a project. iWire365 performs physical Site Surveys on all its applications prior to making statements and commitments to a projects success prior to final contractual engagement.

Performing a physical wireless site survey is the only way to develop accurate wireless path calculations to ensure performance of a wireless backhaul system. A wireless site surveys must be performed for a point-to-point wireless bridge, point to multipoint wireless backhaul, WiMax, LTE, or wireless mesh network. There are many things to take into consideration when surveying a wireless Ethernet bridge, such as line of sight, trees or other Fresnel Zone obstructions, mounting elevations, radio equipment (frequency, path loss, gain, etc.) These and other variables should be addressed to assure that path calculations match up to the 'real world' environment.

A Site Survey may include the following procedures:

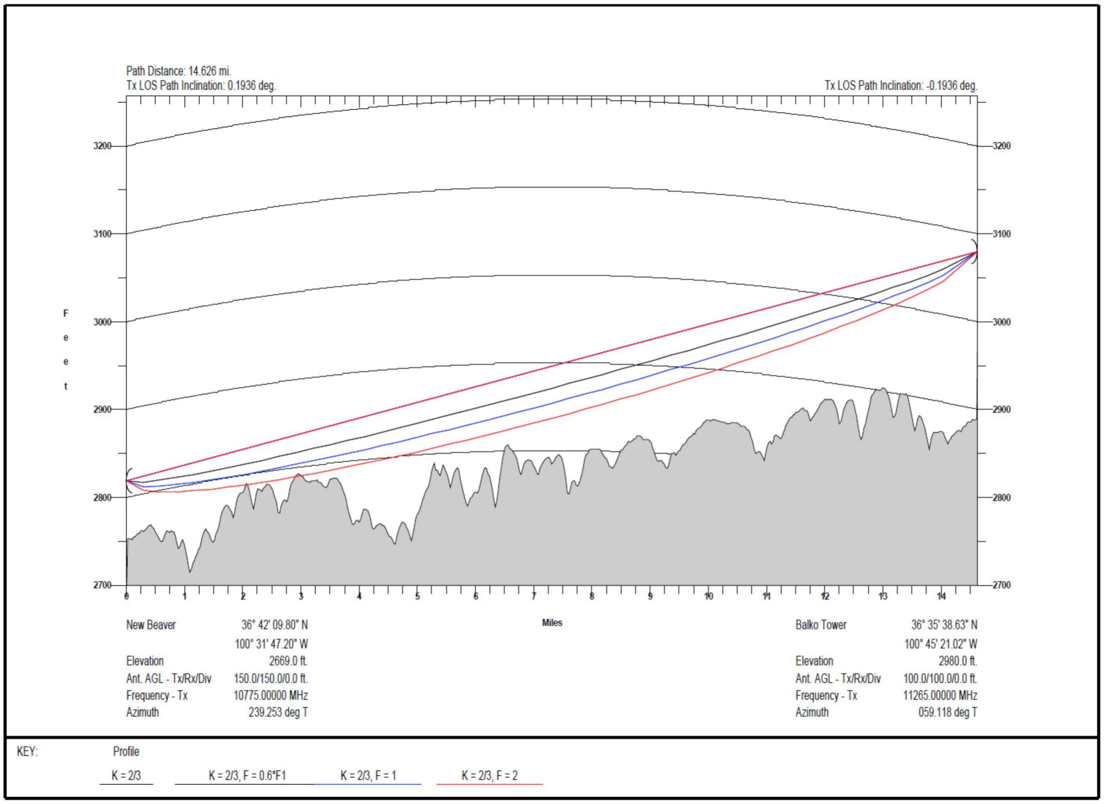
- Capture GPS coordinate readings for path calculations
- Provide digital photographs (facility, path, antenna location, cable routes, etc.)
- Identify locations for mounting solutions (mast / tower).
- Discover present or potential egress points.
- Determine potential obstructions to line-of-sight & Fresnel Zone.
- Identify any possible environmental restrictions.
- Identify any obvious points of wireless interference.
- Discover proper grounding, lighting and surge protection.
- Create Build-of-Materials and product recommendations
- Provide budgetary quotations

Path Analysis

The success of any fixed wireless backhaul implementation starts with performing proper wireless path engineering calculation profiles and creating the correct design. Wireless path calculations should be performed for all forms of fixed wireless backhaul, whether telemetry UHF/VHF radio backhaul, unlicensed wireless Ethernet bridges, licensed microwave links, or millimeter wave 60GHz / 80GHz gigabit wireless (point to point wireless, point to multipoint wireless, or wireless mesh). Microwave path analysis calculations provide factual data used in designing a true and precise path. Designing a proper fixed wireless Ethernet bridge must include the determination of proper wireless equipment, antennas, and cabling to be used, along with the proper system settings, power settings, frequencies, antenna and tower heights, and polarizations used based on the path calculations.

A microwave path analysis provides not only the proper design criteria, but also provides expected performance of a wireless backhaul system. iWire365 performs wireless backhaul path calculations that take into effect the study of topographic map terrain, field verification of path end points, distances between end points, weather, and obstructions. Our link-budget formulations dictate the system parameters expected performance.

Wireless Path Profile Example



Path Distance: 14.626 mi.
Tx LOS Path Inclination: 0.1936 deg.

Tx LOS Path Inclination: -0.1936 deg.

New Beaver	36° 42' 09.80" N 100° 31' 47.20" W	Balko Tower	36° 35' 38.63" N 100° 45' 21.02" W
Elevation	2669.0 ft.	Elevation	2980.0 ft.
Ant. AGL - Tx/Rx/Div	150.0/150.0/0.0 ft.	Ant. AGL - Tx/Rx/Div	100.0/100.0/0.0 ft.
Frequency - Tx	10775.00000 MHz	Frequency - Tx	11265.00000 MHz
Azimuth	239.253 deg T	Azimuth	059.118 deg T

Microwave Link Analysis

		Site A	Site B
Site Name		Water Tower	Mt. Konocti
Location			
Call Sign			
Latitude		38° 57' 37.14" N	38° 59' 22.67" N
Longitude		122° 37' 25.94" W	122° 46' 09.02" W
Elevation	ft/m:	1487.0 / 453.2	3960.0 / 1207.0
Azimuth	deg:	284.5364	104.445
Distance	mi/km:	8.081 / 13.0	8.081 / 13.0
Frequency	MHz:	11000.00000	11000.00000
Equipment			
Tx Antenna Height	ft:	30.00	15.00
Tx Antenna Type			
Tx Antenna Size / Polarization	ft:	3 / V	3 / V
Tx Transmission Line Length	ft:	0.00	0.00
Tx Transmission Line Type			
Rx Antenna Height	ft:	30.00	15.00
Rx Antenna Type			
Rx Antenna Size / Polarization	ft:	3 / V	3 / V
Rx Transmission Line Length	ft:	0.00	0.00
Rx Transmission Line Type			
Effective Isotropic Radiated Power	dBm:	56.10	56.10

System Gains		Site A to B	Site B to A
Tx Antenna Gain	dBi:	39.10	39.10
Rx Antenna Gain	dBi:	39.10	39.10
Transmitter Power	dBm:	17.00	17.00
Total System Gain	dB:	95.20	95.20

System Losses		Site A to B	Site B to A
Free Space Path Loss	dB:	135.558	135.558
Diffraction Loss	dB:	0.00	0.00
Atmospheric Absorption	dB:	0.2	0.2
Foliage Loss	dB:	0.00	0.00
Tx Jumper Loss	dB:	0.00	0.00
Tx Radome Loss	dB:	0.00	0.00
Tx Connector Loss	dB:	0.00	0.00
Tx Transmission Line Loss	dB:	0.00	0.00
Tx Standby Switch Loss	dB:	0.00	0.00
Tx Power Splitter Loss	dB:	0.00	0.00
Tx RF Branching Loss	dB:	0.00	0.00
Tx Attenuator Pad Loss	dB:	0.00	0.00
Tx Miscellaneous & Safety Loss	dB:	0.00	0.00
Rx Connector Loss	dB:	0.00	0.00
Rx Transmission Line Loss	dB:	0.00	0.00
Rx Jumper Loss	dB:	0.00	0.00
Rx Radome Loss	dB:	0.00	0.00
Rx Hybrid Loss	dB:	0.00	0.00
Rx RF Branching Loss	dB:	0.00	0.00
Rx Attenuator Pad Loss	dB:	0.00	0.00
Rx Miscellaneous & Safety Loss	dB:	0.00	0.00
Total System Loss	dB:	135.76	135.76

Path Calculations		Site A to B	Site B to A
Unfaded Receive Signal Level	dBm:	-40.56	-40.56
Rx Threshold Level	dBm:	-63.00	-63.00
Fade Margin	dB:	22.44	22.44
Outage	sec/year:	545.01	545.01
Rain Outage	sec/year:	335.54	335.54
Propagation Reliability	%:	99.99827177	99.99827177

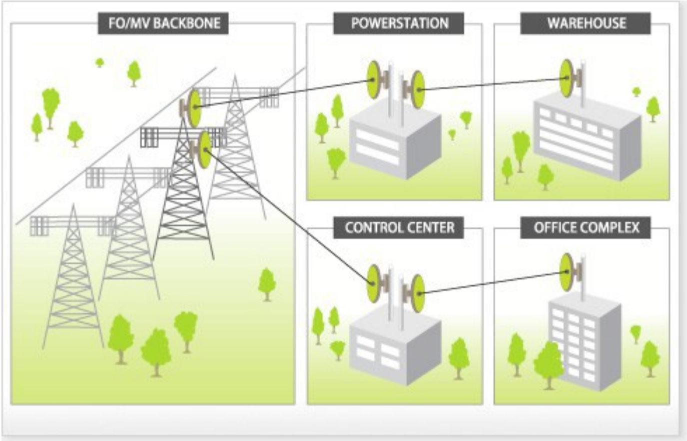
Outage Parameters: Vigants

Climate Factor (c) 0.262 Terrain Factor (w) 140.0 Average Temperature 15.56°C / 60.0°F

Steps

iWire365 takes into consideration on its entire network infrastructure the difference between "Value Line" and "Carrier Grade" equipment, proper use of wireless spectrum, security, network topology, and complete redundancy. In order to provide a long-term, reliable, interference free, and scalable wireless infrastructure it is important to use best of breed, carrier grade infrastructure, along with the use of proper frequency spectrum.

All infrastructure used in Critical Data Network's network design in Carrier Grade and hardened and designed for long-term solutions. Also in our network design all equipment is designed to provide carrier grade performance, high bandwidth and low latency. All iWire365' infrastructure is designed for true fiber replacement at sub- millisecond latency and engineered to provide 99.999% predictable reliability.



Only Fully Licensed Spectrum Used

For a core backbone network iWire365 believes in utilizing only licensed point-to point microwave networks. Licensed microwave links, also known as fixed wireless backhaul, are more reliable as a result of noise interference in unlicensed wireless spectrum, such as: 5.8GHz wireless bridge systems. Licensed microwave provides security from the risk of wireless interference from other outdoor wireless systems. Interference can degrade an outdoor wireless bridge system's performance and in some cases even prevent the system from functioning at all. Licensed microwave link systems can be engineered to provide predictable reliability of 99.999% uptime.

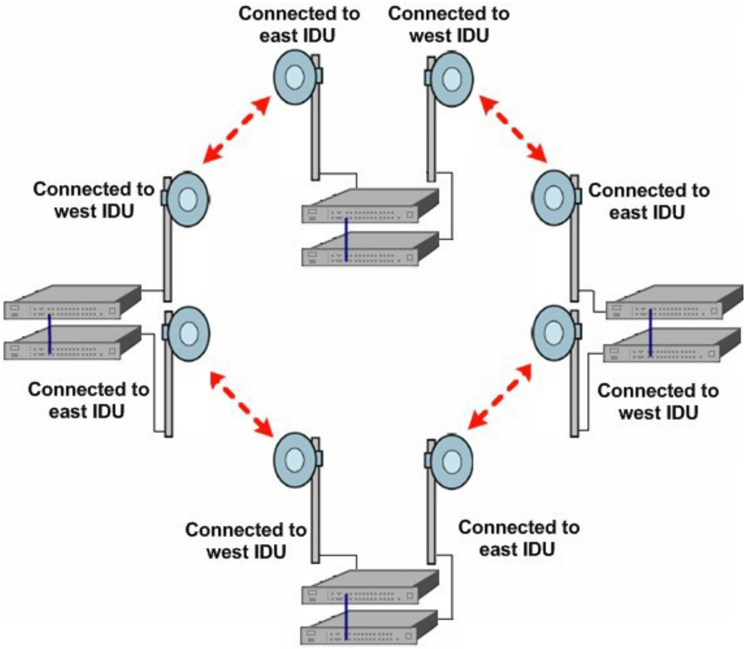
Licensed microwave wireless bridge systems operate within parts of the radio spectrum (UHF/VHF, LTE (700MHz), MAS 900MHz, 2.5GHz WiMax, 6GHz, 7GHz, 11GHz, 13GHz, 18GHz, and 23GHz) designated by the FCC. To operate a licensed microwave wireless backhaul radio system a license from the FCC must be obtained. Licensed operators are permitted exclusive use of part of the band over an assigned geographic area. Licensed microwave wireless Ethernet bridges can go distances up to 50+ miles and provide data rates upwards of GigE Full Duplex and beyond.

Security

iWire365 also ensures all its wireless infrastructure meets the highest security standards, meeting or exceeding DOD specifications. All of the systems that iWire365 deploy are protected by use of licensed only frequencies, proprietary encoding and decoding methods, and use of both hardware and software AES-256bit encryption technologies. Because iWire365 only utilizes FCC licensed spectrum and radio systems that are paired to each other, sensitive data can not be captured or sniffed over the air, unlike with unlicensed off the shelf products used by most other organizations.

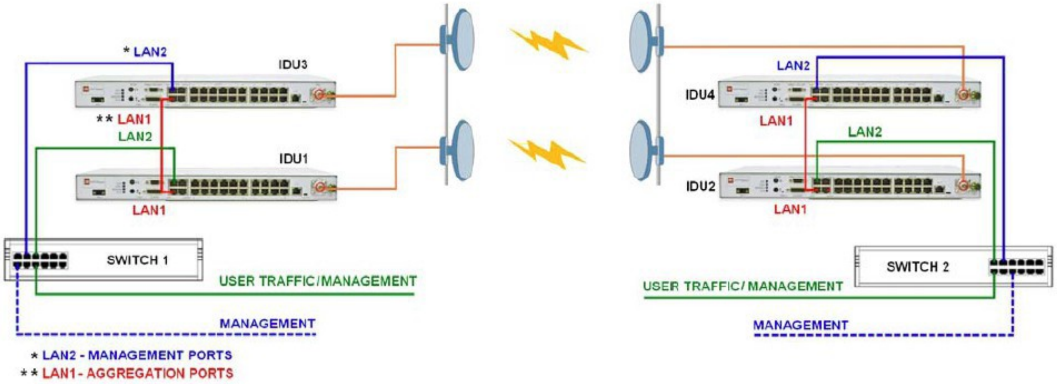
Network Design

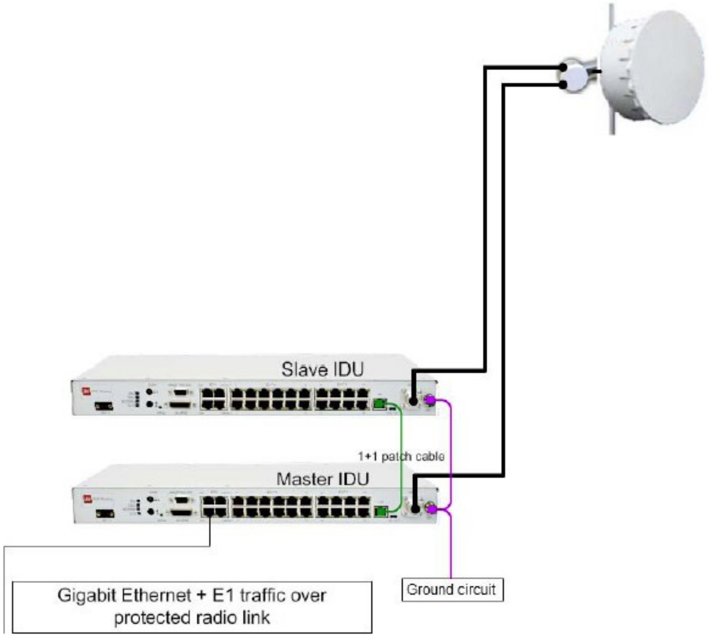
iWire365, on all its networks, builds in multiple layers of redundancy. Where possible, iWire365 uses a Ring Topology with use of Spanning Tree, Rapid Spanning Tree, and/or MPLS technologies for it's first layer of redundancy. Our goal is to have multiple routes in and out of each core communication sites. If one data path were to fail or take on issues the network will still have reliable routes eliminating downtime at any critical juncture of the network.



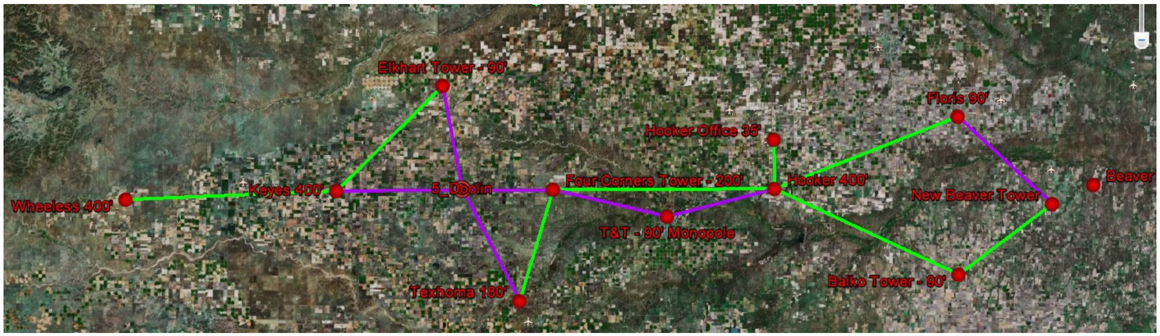
On top of the use of Ring Topology networks, iWire365 implements XPIC and 2+0, 3+0, or 4+0 configurations. Utilizing 2+0 configurations allows us to achieve higher bandwidth while providing complete failover redundancy. If one backhaul radio system were to fail or have issues (like a blown piece of hardware or failed power supply) the system will automatically default down to the other link on the same path providing redundancy. Also as an additional layer of redundancy iWire365 uses back up power supplies and UPS on all its systems.

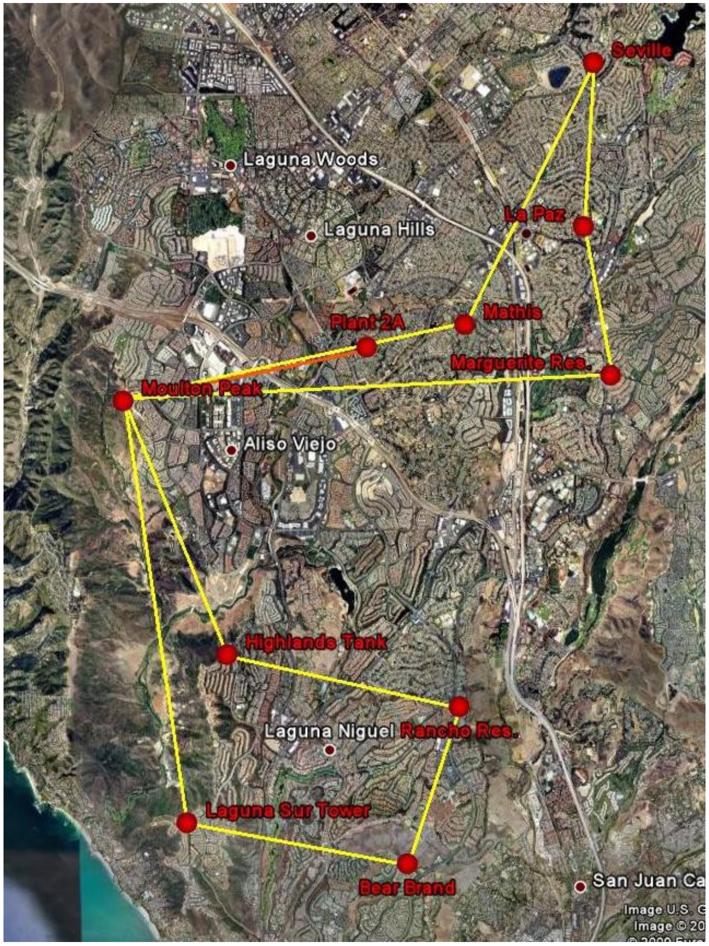
Example of 2+0 Topology





Examples of Network Design Layouts





Process

iWire365's ("i365") takes into consideration on its entire network infrastructure the overall end data connectivity points and the need for mobility ("mobile access"). iWire365's infrastructure is based on "Best Practices" in the industry. After a proper Site Survey and RF Analysis have been performed I365 can determine the best type of Last Mile (from the end network node back to the core backbone network) connectivity.

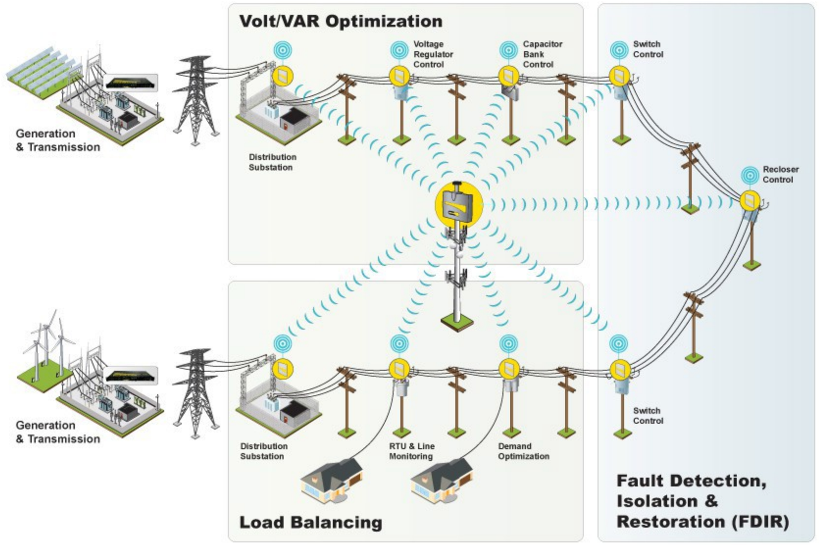
iWire365 has the ability to use, through permissions of the FCC, licensed 2.5GHz WiMax spectrum and licensed LTE D (First Net) and E block 700MHz spectrum. It is I365's philosophy to use licensed spectrum in its network design and deployments to provide the greatest possible reliability and security.

Another key component of I365's design is the ability to scale. Far too many times organizations head down a path that ends up in bottlenecks or will not allow them to scale. Many times organizations spend a lot of CAPEX on equipment that only has a 5 year mean to failure time rating unknowingly. All of I365's infrastructure is hardened and can even handle high EMF sites, like power substations.

Last Mile System Types – Basic fixed location sites

In designing a system to backhaul fewer than 40 fixed end nodes I365 would first consider a Point-to-Multipoint system. Possible frequencies, depending on bandwidth requirements, can be licensed VHF/UHF, licensed MAS 900MHz, or 2.5GHz licensed WiMax. This solution would provide fixed connectivity from the end site back to a Base Station at a location on the core network.

Optionally a wireless Mesh System may provide the best possible paths. In some cases a combination of a Mesh and Point-to-Multipoint may produce the best results. In some paths that are single location in an of azimuth location a single point-to-point bridge may be used. A point to multipoint system to fixed locations can provide upwards of 100Mbps to a remote site.



Point-to-Multipoint wireless backhaul systems are made up of a Base Station Unit (BSU) that can communicate with multiple Subscriber Units (SU's). In most cases the BSU's provide a sector antenna beam pattern (typical is 60 degree, with some systems allowing external antenna configurations for expanding to 90 and 120 degree sector antennas).

Multiple BSU's can be installed to create a 360-degree sector (like a typical cell site configuration).

Last Mile System Types – Large number of fixed sites

For applications where I365 is to provide last mile connectivity to a large number of either fixed locations I365 typically utilizes either licensed WiMax or LTE technology. The type of technology is based on coverage area and amount of end point connections. In some cases both technologies can be used.

LTE can provide coverage areas in a macro cell of greater than 20+ miles. Ideal wireless communication coverage areas can be up to 11 miles with good coverage. LTE sites are typically on communication towers that are spaced out geographically. These sites can be connected either via fiber or by using point to point wireless bridges, like licensed microwave backhaul.

Last Mile System Types – Fixed sites and mobility

In many applications, I365 is tasked with creating IP network connectivity to both fixed and mobility (vehicle) nodes. iWire365 network infrastructure allows for scalable solutions to provide fixed end node sites as well as provide mobility solutions for vehicle connectivity, in vehicle Wi-Fi, mobile workforce connectivity (e.g. laptop, tablet, smart devices, and other handheld devices), and critical asset tracking and management (e.g. vehicle, trailer, generator, container, etc.) in order to track high value assets.

With I365's licensed WiMax and LTE spectrum use mission critical connectivity can be provided with interference free operations and with the best Carrier Grade connectivity possible. I365's reach can provide data connectivity downlinks and uplinks to locations that fiber and copper just can't reach. Remote sites for Smart Grid, First Net, SCADA telemetry, both commercial and residential locations, and remote work force can be provided high speed connectivity even where cellular signals are not present.

About iWire365

iWire365 is a Dallas based organization that combines wireless telecom infrastructure and business/IT application services, focused strictly on the rural cooperative and municipal utility markets. The iWire365 model mitigates capital and technology risks, while providing the lowest possible cost of service and the highest level of customer satisfaction.

For more information about our solutions and capabilities, please contact us today.

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